A pint a day raises a man's pay; but smoking blows that gain away

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Abstract

This paper studies the wage effects of the use of alcohol and tobacco. The analysis based on a recent survey in the Netherlands shows that for males the use of tobacco has a negative wage effect of about 10% while the use of alcohol has a positive wage effect of about the same size. The wages of females are not affected by smoking and drinking.

Keywords: drinking, smoking, wages, earnings regressions
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1 Introduction

There is a small literature on the relationship between drinking, smoking and labor market performance. Most of the studies in this literature focus on the effect of alcohol on wages, some studies are on the influence of smoking on wages and there are also a few studies on the simultaneous effect of smoking and drinking on wages.[1]

The studies based on US, Canadian or Australian data all find positive wage effects of moderate alcohol use.[2] The positive wage effects of drinking are explained through the relationship between drinking and health. Moderate drinkers have a smaller probability to be confronted with coronary heart disease than abstainers or heavy drinkers have. The exact nature of the relationship between alcohol use and wages differs. Basically, there are two types of results. Drinking has a positive but constant wage effect over some range of use. Or there is an inverted U-shape relationship where there is a maximum positive wage effect at some drinking intensity while drinking more or drinking less induces a smaller wage effect. Examples of the first type of studies are Berger and Leigh (1988) and Zarkin et al. (1998). Berger and Leigh (1988) find that drinkers receive higher wages than non-drinkers. Zarkin et al. (1998) conclude that men who use alcohol over a wide range of consumption levels have 7% higher wages than men who do not drink or are heavy drinkers. The study does not find a statistically significant alcohol wage premium for females. Examples of the second type of studies are French and Zarkin (1995), Heien (1996), Hamilton and Hamilton (1997) and MacDonald and Shields (2001).[3] French and Zarkin (1995) find that individuals who consume 1.5 to 2.5 alcoholic drinks per day have significantly higher wages than abstainers and heavy drinkers. Heien (1996) finds that at the optimal level of alcohol consumption the wage premium of alcohol is around 50%. Hamilton and Hamilton (1997) find a non-linear effect of alcohol use on wages but only after accounting for endogeneity in the choice of drinking status. MacDonald and Shields (2001) study the effect of alcohol consumption on occupational attainment in England. They find both for OLS and 2SLS estimates that

[1] There is also research on the use of soft and hard drugs in relation to labor supply. See for an overview of the literature on drugs and labor market performance MacDonald and Pudney (2000).

[2] An exception is Dave and Kaestner (2002) who claim that there is no causal effect of alcohol consumption on labor supply and wages.

[3] Tekin (2002) analyses Russian data and finds an inverse u-shaped relationship between wages and alcohol consumption. After introducing fixed effects the u-shape disappears but there is still a positive relationship between wages and alcohol consumption.

there is a positive association between alcohol consumption and mean occupational wages that appears to have an inverted-U shape form. The 2SLS estimates indicate an optimal alcohol consumption equivalent to about 2 pints of beer a day for males and about 1.5 per day for females. MacDonald and Shields (2001) argue that the positive effect of moderate alcohol use may be related to social networking. Their idea is that alcohol consumption is associated with additional social time spent with work colleagues and associates. The social networking also signals to more senior members of staff the motivation for the job and commitment to the firm. So, alcohol induced social networking provides workers with valuable information that helps their careers and thus stimulates their wages.

The study by Levine et al. (1997) is a rare exception of a study that investigates the effect of smoking on wages. They find that conditional on their observed characteristics workers who smoke earn 4-8% less than nonsmokers. In their opinion this negative effect of smoking on wages can be attributed to discrimination of smokers, their reduced ability to carry out manual tasks, their increased absenteeism or their high rate of time preference, which induces them to make fewer investments in productivity enhancing human capital. The results are partly based on panel estimates focusing on differences in wage changes between workers that quit smoking and workers that continue smoking. Unfortunately, the investigation on the possible nature of the negative wage effect is without results.

Studies that investigate the simultaneous effects of smoking and drinking on wages are Auld (1998), Lee (1999) and Lye and Hirschberg (2001). Auld (1998) finds that abstention from alcohol incurs a wage loss of 10% while being a daily smoker is associated with a wage loss of 8%. After accounting for simultaneity he finds that drinking abstention and heavy drinking are associated with an income penalty of 25% to 50%, whereas a daily smoker has a wage of about 30% lower than a non-smoker. Lee (1999) analyses a sample of twin data and finds that drinkers earn 4% more than abstainers while smokers earn 5% less than non-smokers. Lye and Hirschberg (2001) find a non-linear relationship between alcohol use and wages but only for non-smokers. For smokers no positive wage effect of the use of alcohol is found.

The focus of the current paper is on the simultaneous wage effects of the use of alcohol and tobacco. The analysis uses data from a 2001 survey in the Netherlands. From OLS wage regressions it appears that for males drinking has a wage premium of 13% while smoking has a wage penalty of 6%. Both the positive wage effect of drinking and the negative effect of smoking could be related to health effects and to the effect of social networking. However, it could also be that there are unobserved characteristics that affect both smoking/drinking behavior and wages in which case OLS-estimates are biased. The main issue of the current paper is to estimate the effects of smoking and drinking on wages taking into account the effects of possible unobserved heterogeneity. A traditional way is to use instrumental variables where frequently used instruments are religion, prices of alcoholic beverages, diseases, self-assessment or family behavior.[4] In 2SLS estimates I use as instrumental variables whether or not an individual started drinking or smoking before age 16. Furthermore in alternative estimates I also use the presence of a partner, the presence of children and a socioeconomic status indicator as instruments. In all cases I find that the positive effect of drinking increases to implausibly high values. Such increases in the effect of drinking when applying 2SLS (or 3SLS) are also found in studies by Zarkin et al. (1998), Heien (1996) and Auld (1998). The size of the effects of alcohol use are very implausible. Apparently it is not easy to find good instrumental variables that affect the choice to drink alcohol but do not directly affect the wage. Therefore, as an alternative to the usual instrumental variable approach I use the analysis of starting rates for alcohol and tobacco to identify the presence of unobserved heterogeneity and relate this to unobserved heterogeneity in the wage equation. My alternative estimates show that alcohol use generates a wage premium for males of about 10% while smoking reduces wages by about 10%. For females I do not find that drinking or smoking affect wages.

The paper is set up as follows. Section 2 gives stylized facts about the labor market position and smoking and drinking of the individuals in the dataset. Section 3 presents parameter estimates of the starting rates for alcohol and tobacco and parameter estimates of the intensity of use of tobacco and alcohol. Section 4 gives the results of several wage regressions in which the use of tobacco and the use of alcohol are explanatory variables. Section 5 concludes.

2 Labor market position, smoking and drinking

The data used in the analysis are collected just before Christmas 2001 (see the Appendix for details about the data). The gross dataset contains information on 1010 males and 820 females aged 16 years and older. Table 1 shows the labor market position of these individuals distinguished by age and gender. Only a few individuals are unemployed.

[4] MacDonald and Shields (2001) for example use instrumental variables related to illnesses of the interviewee (diabetes, stomach ulcers and asthma), the parents of the interviewee (whether or not they smoked regularly) and self-assessment about the drinking behavior of the interviewee.

For males the share of unemployed ranges from 1 to 3%, for females this is somewhat higher ranging from 3 to 7%. Only for the lowest age category and the highest age category males and females are very much alike. For both males and females the age category 16 to 25 years contains a little over 50% of employed workers, while a bit more than 40% is non-participant. These are mainly individuals that have full time education. For the highest age category almost all individuals are non-participants. In the age groups 26 to 35 years and 36 to 45 years almost all males are employed. In the category 46 to 55 years there are more non-participants, mainly because some of the males retire early or collect disability benefits. In the age category 56 to 65 years only 40% of the males is employed, while 60% is non-participant, early retired worker or a worker collecting disability benefits. For females the age category 26 to 35 years has the highest employment share, 86%, while 10% of this age category is non-participant. At higher ages the employment share drops substantially to 17% for the age category 56 to 65 years.

Table 2 shows the use of tobacco and alcohol by age group and gender. The indicators shown are lifetime prevalence, last year prevalence and last month prevalence. In most studies it is not possible to study past use independently of current use because last month prevalence automatically implies lifetime prevalence. Here these standard indicators are somewhat adjusted. Lifetime prevalence concerns ever use up to last year, last year prevalence concerns the use last year up to last month, last month prevalence concerns the use during last month. As shown in Table 2 for males tobacco lifetime prevalence increases with age. From 45 years onwards at least 85% of the males has ever smoked. For females there is an increase up to the age category 46 to 55 years. At higher ages less females have ever smoked, a phenomenon that is clearly a cohort effect. For most age groups last year prevalence is substantially smaller than lifetime prevalence indicating that many individuals that ever smoked have stopped smoking. Since the differences between last year prevalence and last month prevalence are small not many individuals have stopped recently. Except for the youngest and the oldest there is not much difference between the age groups in terms of last year or last month prevalence of tobacco. For alcohol the three indicators are not very much different and with the exception of the oldest group of females none of the prevalence indicators is very much different across the age groups. Apparently, the use of alcohol is a phenomenon that does not differ a lot between population groups.

A helpful indicator to distinguish between regular use and incidental use is whether an individual that has ever used alcohol or tobacco has done this more than 25 times. Table 3 gives an overview of this intensity of use indicator again distinguished by gender and age group. For tobacco the high intensity of use indicator is substantially below the lifetime prevalence indicating that a lot of individuals have smoked tobacco in the past but not very frequently. For alcohol the high intensity of use indicator is not much different from the lifetime prevalence indicating that those that use alcohol do this on a very regular basis.

Finally, an important indicator of the use of alcohol and tobacco is what individuals indicate as 'normal' use. To illustrate this I use the following five categories for tobacco based on what is reported as the number of cigarettes, cigars or pipes the individual 'normally' smokes during a day: 0, 1-2, 3-10, 11-20, 20+. For alcohol I use eight categories based on what is reported as the number of glasses of alcohol (beer, wine, gin) the individual 'normally' drinks during a period of 30 days i.e. a month:[5] 0, 1-5, 6-16, 17-31, 32-62, 63-93, 94-124 and 125 or more drinks. In this paper I focus on individuals from 26 to 55 years. Among individuals below this age range as well as among individuals above this age range there are many non-participants. Table 4 shows for the age group 26 to 55 years the distribution smoking and drinking distinguished by gender. It appears that about 60% of the males and females in the sample do not smoke anymore or have never smoked. Between males and females there is not a big difference in the distribution of smoking intensity. Of the males 8% smokes more than 20 cigarettes per day, for females this concerns 5% of the sample. Table 4 also indicates that for those that smoke, the average number of cigarettes per day is about 13.

For alcohol the differences in use between males and females are larger. Of the males 7% indicate not to drink, while for females this is 16%. On the other hand 40% of the males indicate to drink on average at least one glass per day, while for females only 20% indicate doing this. The average use for those that drink is a little over 1.5 glass of alcohol per day for males, while for females it is a little less than 1 glass of alcohol per day.

3 Alcohol and tobacco use

3.1 Starting rates

In the study of the use of alcohol and tobacco I begin with starting rates. For this I apply hazard rate analysis, a technique that is frequently used in the analysis of labor market dynamics. Lancaster (1990) gives an

[5]These categories are also used in Zarkin et al. (1998). Another way to interpret these categories is: 0, up to 1 drink per week, from 1 drink per week up to 1 drink every other day, from 1 drink every other day up to 1 drink per day, 1 to 2 drinks per day, 2 to 3 drinks per day, 3 to 4 drinks per day and 4 or more drinks per day.

extensive treatment of this type of models. Van den Berg (2001) presents a recent overview of duration models including a discussion on the use of bivariate duration models.

Figure 1 shows the empirical starting rates. Figure 1a shows that most of the action in terms of starting to smoke is between age 14 and 19. The peak in the starting rate for females is at age 16, when almost 20% of the females that did not start smoking until then started smoking at that age. For males there are peaks at ages 15, 16 and 18, with starting rates of almost 20%. Figure 1b shows that also for starting to drink most of the action is in the age range from 14 to 19. The dip at age 11 is due to the fact that the (few) individuals that indicated to have started drinking below age 10 are assumed to have started at age 10. For males there is a peak in the starting rate at age 16, when more than 50% that have not started until then start drinking alcohol at that age. For females there are peaks in the alcohol starting rates of more than 30% at age 16 and 18.

The starting point in the current analysis is the mixed proportional hazard model with a flexible baseline hazard. Differences between individuals in the rates by which they start using alcohol and tobacco are assumed to be related to observed characteristics, the elapsed duration of time they are exposed to potential use and unobserved characteristics. I take age 10 to be the time at which the potential exposure to alcohol and tobacco starts.

The starting rate for alcohol, at time t conditional on observed characteristics x and unobserved characteristics v_a is specified as

$$\theta_a(t \mid x, v_a) = \lambda_a(t) \exp(x' \beta_a + v_a) \tag{1}$$

where $\lambda_a(t)$ represents individual duration (age) dependence and β_a represents a vector of coefficients. I model flexible duration dependence by using a step function:

$$\lambda_a(t) = \exp(\Sigma_k \lambda_{a,k} I_k(t)) \tag{2}$$

where k (= 1,..,11) is a subscript for age-interval and $I_k(t)$ are time-varying dummy variables that are one in subsequent age-intervals. I distinguish 11 age intervals of which 10 are of one year (age 10, 11, .., 19) and the last interval is open: $\geq$20 years. Because I also estimate a constant term, I normalize $\lambda_{a,1} = 0$.

The individual starting rate for tobacco is modelled in the same way

$$\theta_b(t \mid x, v_b) = \lambda_b(t) \exp(x' \beta_b + v_b) \tag{3}$$

The conditional density functions of the completed durations of non-use can be written as

$$f_j(t_j \mid x, v_j) = \theta_j(t_j \mid x, v_j) \exp(-\int_0^t \theta_j(s_j \mid x, v_j) ds) \qquad \text{for } j = a, b \tag{4}$$

I take the possible correlation between the unobserved components in the starting rates for alcohol and tobacco into account by specifying the joint density function of the two durations of non use t_a and t_b conditional on x as

$$h(t_a, t_b \mid x) = \int_{v_a} \int_{v_b} f_a(t_a \mid x, v_a) f_b(t_b \mid x, v_b) dG(v_a, v_b) \tag{5}$$

I model the joint distribution of unobserved heterogeneity assuming a discrete distribution $G(v_a, v_b)$ where both unobserved components (random effects) have two points of support.[6] This implies that there may be four types of individuals that differ in their inclination towards the use of alcohol and tobacco:

$$\Pr(v_a = v_{1,a}, v_b = v_{1,b}) = p_1 \qquad \Pr(v_a = v_{1,a}, v_b = v_{2,b}) = p_2$$

$$\Pr(v_a = v_{2,a}, v_b = v_{1,b}) = p_3 \qquad \Pr(v_a = v_{2,a}, v_b = v_{2,b}) = p_4 \tag{6}$$

where $0 \leq p_n \leq 1$, $n = 1, .., 4$ and $p_n = \exp(\alpha_n)/\sum_n \exp(\alpha_n)$, with normalization $\alpha_4 = 0$ to have a multinomial logit specification. The covariance of ν_a and ν_b equals

$$cov(\nu_a, \nu_b) = (p_1 p_4 - p_2 p_3).(v_{1,a} - v_{2,a}).(v_{1,b} - v_{2,b})$$

The variables v_a and v_b are perfectly correlated if $p_1 = p_4 = 0$ or $p_2 = p_3 = 0$. So, in case of perfect correlation the distribution of unobserved heterogeneity has two points of support.

The explanatory variables are education and religion. Higher educated individuals may be more informed about health problems related to smoking or health benefits related to drinking. Religion may have a negative effect on smoking and drinking for obvious reasons.

The analysis is done separately for males and females and takes account of the fact that some individuals have not started using alcohol or

[6] Heckman and Singer (1984) suggest that for unobserved heterogeneity in hazard rate models discrete distributions can approximate any arbitrary distribution function G. Van den Berg et al. (2004) present a recent analysis in which the distribution of unobserved heterogeneity in a bivariate duration model is discrete. The starting point is a discrete distribution with four points of support. In the empirical analysis only two points are identified. Mroz (1999) discusses the use of discrete factor approximations in simultaneous equation models.

tobacco at the time of the survey but may start in the future, i.e. their durations of non-use are right-censored. The parameters are estimated using the method of maximum likelihood. The parameter estimates are shown in Table 5.[7]

Both starting rates have two mass points, but they are perfectly correlated.[8] For tobacco one of the mass points goes to minus infinity which indicates that there is a group of men that will never start smoking. For alcohol the second mass point is significantly lower than the first mass point.[9] The parameter of the mass point distribution indicates that - conditional on the observed characteristics and the pattern of duration dependence - there is a group representing 87% of the men, which have positive starting rates for both tobacco and alcohol. The remaining group of 13% of the men have a low starting rate for alcohol and a zero starting rate for tobacco.

For males none of the coefficients of the explanatory variables is different from zero at conventional levels of significance. The pattern of duration dependence reveals that the maximum starting rate for tobacco is at age 18, while for alcohol the maximum starting rate is at age 16.

For females education is negatively related to the starting rate for tobacco and positively related to the starting rate of alcohol. Furthermore, Catholic and Protestant females are less likely to start smoking than females with no religion or a different type of religion. Conditional on their observed characteristics, the peak of the female starting rates for tobacco and alcohol is at age 16. Conditional on the observed characteristics and the age dependence there is no clear evidence of the presence of unobserved characteristics. The second mass point for the alcohol starting rate is not significantly different from the first one and when ignoring the presence of unobserved heterogeneity the value of the loglikelihood does not change very much.[10]

3.2 Current use of alcohol and tobacco

The empirical analysis continues with an investigation of the determinants of the intensity of current use concerning tobacco and alcohol.

[7] Note that in stead of estimating v_2 the difference $v_2 - v_1$ is estimated.

[8] Attempts to identify more than two mass points failed. This is probably due to the fact that smoking without alcohol use rarely occurs.

[9] The Likelihood Ratio test statistic comparing a model with and without unobserved heterogeneity is equal to 17.4, which would be significant at a 1% level and 3 degrees of freedom (the critical $\chi^2_{0.01} = 11.3$). However, note that a formal $LR-$test is problematic since one of the parameters (p) is not identified under the null hypothesis.

[10] The formal LR test statistic = 5.6, which would not be different from zero at a 5%-level of significance.

The intensity of use is assumed to depend on personal characteristics and whether or not an individual started using tobacco or alcohol early on, that is before the age of 16:

$$\ln(y_{ji}+1) = \beta_{j0} + \beta_{j1}x_i + \beta_{j2}z_{ji} + \varepsilon_{ji} \qquad \text{for } j = a, b \tag{7}$$

where y is the intensity of use of tobacco or alcohol of person i. The logarithmic specification reduces the influence of outliers, accounts for non-linearity and for the fact that the intensity of use is non-negative. Furthermore, x represents a vector of personal characteristics. In the analysis of starting rates only a limited number of characteristics could be taken into account because it concerned processes in the past. Here, additional variables like family position and socioeconomic position can also be taken into account. Intensity of smoking and drinking changes over the life cycle but also family position may be relevant. Individuals with a partner and/or with children may adjust their smoking behavior to avoid negative health problems (passive smoking) for their family members. Individuals with a low socioeconomic status may smoke more because they are less aware of health problems related to smoking. Finally, z represents early alcohol or tobacco use, β are parameters of interest and ε is the error term. Table 6 shows the estimation results.

For males age has a positive effect on tobacco use although the coefficient is significant only at the 10% level. This is probably related to a cohort effect. Education does not have an effect but males with partners smoke less than their counterparts do. Neither the presence of children in the family nor religion affects the smoking behavior of males. Males with a low socioeconomic statues smoke more than males with a higher socioeconomic status. Finally, males that start early, i.e. begin smoking before age 16 have a significant higher tobacco use than individuals that start later on (or do not start at all). Concerning alcohol use of males only age and early start have a (positive) effect.

By and large females have similar determinants. Females smoke more if they are low educated, have no partner, have a low socioeconomic statues or were an early smoker. They drink more at higher age and if they started drinking early in life. Catholic and Protestant females drink less than females without religion or with a different type of religion, while religion does not affect smoking behavior.

4 Wage effects of tobacco and alcohol use

4.1 OLS parameter estimates

To investigate the effect of the use of alcohol and tobacco on wages I use a restricted dataset of which the main characteristics are also shown in the

Appendix. The hourly wage is calculated as the ratio of personal income and number of working hours. I restricted the sample to individuals indicating to work between 10 and 60 hours per week.[11] Furthermore, I only used information about individuals for which the hourly wage was at least 10 guilders and at most 70 guilders.[12] As shown in Table A2 the average hourly wages are about 33 guilders for males and 29 guilders for females. The wage equations are specified as:

$$w_i = \gamma_0 + \gamma_1 x_i + \gamma_2 \widetilde{y}_{ai} + \gamma_3 \widetilde{y}_{bi} + \epsilon_i \tag{8}$$

where w represents log hourly wages, x represents personal characteristics (age and education) and $\widetilde{y}_a$ and $\widetilde{y}_a$ are indicators of the intensity of tobacco and alcohol use. Furthermore, ϵ is the error term of which I initially assume that it is i.i.d. and γ is the vector of parameters of interest.

I start with estimates in which the indicator of tobacco and alcohol use are specified using a number of dummy variables representing the categories specified in Table 4.[13] The estimation results are shown in Table 7. It appears that age has a positive effect on the wages of both males and females. For every year they grow older male wage increases with 1.2%, while females experience an annual wage increase of 0.6%.[14] Highly educated individuals earn about 35% more than individuals without education. Tobacco use has a negative effect on the hourly wage rate of males, although only for the category 3 to 10 cigarettes per day this effect is different from zero at a 5% level of significance. For this category the hourly wage is about 11% lower than it is for non-smokers. Alcohol use has a positive effect on the male wage rate, although for the category 1-5 glasses per month and more than 120 glasses per month the effect does not differ significantly from zero at a 5% level. The peak of the effect is for the category 63-93 glasses per month, which has a wage that is about 27% higher than wages on non-drinkers. For females there is hardly any effect of alcohol or tobacco use. The exception is the category of heavy drinkers that has a wage that is 26% higher than the wage of non-drinking females, although the relevant coefficient is only significant at a 10%-level.

From Table 7 I conclude that for males wages are affected by both smoking and drinking while for females this does not seem to be the

[11] One individual indicated to work 120 hours per week.

[12] A guilder is equivalent to 0.44 Euro.

[13] To account for possible selection bias due to the fact that not every individual in the sample has a job I did separate estimates adding Heckman's sample selection term but did not find a significant parameter connected to this term.

[14] The coefficients of a quadratic term do not differ significantly from zero.

case. Furthermore, it seems as if the effect of both alcohol and tobacco on the wages of males is nonlinear. To investigate this in more detail I distinguish two specifications of use. The first and fourth column in the upper part of Table 8 report estimates of wage equations in which tobacco use and alcohol use are specified as continuous variables: $\widetilde{y}_{ai} = \ln(y_{ai} + 1)$; $\widetilde{y}_{bi} = \ln(y_{bi} + 1)$. In other words the dependent variables in equation (7) are explanatory variables in equation (8). The coefficients of age and education are almost the same as those in Table 7. Tobacco use has a significant negative effect and alcohol use has a significant positive effect on the hourly wage of males. The parameter estimates for females wages indicate that tobacco use has no effect, while alcohol use has a positive effect. This latter effect has to do with the large positive wage effect of heavy drinking (see Table 7).

The first and fourth column in the lower part of Table 8 concern wage equations where tobacco use and alcohol use are specified as dummy variables: $\widetilde{y}_{ai} = I(y_{ai} > 0)$; $\widetilde{y}_{bi} = I(y_{bi} > 0)$. The parameter estimates show that conditional on their other characteristics males that smoke have an hourly wage that is about 6% lower than that of non-smokers. Alcohol drinkers have a wage that is about 13% higher than the wage of abstainers.[15] At first sight it may seem strange that for males the largest negative effect of tobacco use is for those that smoke 3-10 cigarettes per day, while for those that smoke more than 20 cigarettes per day the effect is insignificantly negative. However, when I estimate a separate coefficient of a dummy variable of heavy smoking in addition to a dummy variable indicating smoking the coefficient of heavy smoking does not differ significantly from zero. This indicates that conditional on the observed personal characteristics the wage of heavy smokers is not different from the wage of light smokers. Female wages are not affected by alcohol use or tobacco use.

4.2 2SLS parameter estimates

Although it seems as if drinking has a positive effect on male wages and smoking has a negative effect it cannot be ruled out that there are unobserved determinants that simultaneously affect smoking, drinking and wages. If that is the case it could be that the true causal effects differ from the effects presented in the previous subsection. To account for the effects of unobserved heterogeneity and possible endogeneity of smoking and drinking I start with traditional 2SLS estimation procedures.

[15] I tried whether smoking 1-2 cigarettes per day or drinking heavily contributed to the explanation of the wage but in neither case I found significant coefficients. I also investigated whether the size of the effects of smoking and drinking is related to the educational level but found no evidence of this.

In search for instrumental variables, i.e. variables that affect drug use but do not directly affect wages, I use the estimation results presented in Table 6. From this table it appears that 'partner' and 'early start' affect both tobacco use and alcohol use. I assume that these variables do not directly affect the wage rate so they can be used as instruments for alcohol use and tobacco use. The first and second column of the upper part of Table 9 present the estimation results. The first column shows that for females the coefficients for alcohol or tobacco are not significantly different from zero. This being the case the remainder of the paper focuses on the wages of males.

The second column of Table 9 shows that also after accounting for potential endogeneity, on wages of males tobacco use has a negative effect while alcohol use has a positive effect. The problem with these parameter estimates is that the estimated coefficients for tobacco and alcohol are five times as large as the parameter estimates presented in Table 8.[16] So, like previous studies I find that 2SLS-estimates generate a huge increase in the estimated effect of alcohol on male wages.[17] The third column shows the estimation results if only 'partner' and 'early start alcohol use' are instruments. Now, the coefficient of tobacco use doubles while the coefficient of alcohol use is hardly affected. It may be that 'partner' is not a good instrument as it may have a direct effect on wages and not just through the drinking and smoking behavior. Therefore, in the lower part of Table 9 parameter estimates are presented if 'partner' is replaced by other instruments. The first column shows the parameter estimates with 'children' as instrumental variable. The parameter estimates for tobacco use and alcohol use do not change a lot. The second column of the lower part of Table 9 shows that the parameter estimates are very similar if 'low socioeconomic status' is used as an instrument. The third column of the lower part of Table 9 shows that the parameter estimates of alcohol use and tobacco use do not change a lot if 'partner' is no longer

[16] A Hausman test for overidentification has a value of 3.35. Since the critical $\chi^2_{0.05} = 3.84$. I cannot reject the hypothesis that there are no exogenous variables in the model that have been inappropriately omitted from the wage equation. A LR-statistic comparing the reduced form wage equation with and without the instruments has a value of 13.8. Table 6 shows the relationship between the instrumental variables and the endogenous variables in the wage equation.

[17] Auld (1998) stresses that it is important to take simultaneity into account. Wage (or rather income) affects the use of alcohol and tobacco as well as the other way around. If alcohol is a normal good and tobacco is an inferior good and they are nevertheless treated as exogenous alcohol will have a positive effect on wages and tobacco a negative effect. To take account of this feedback mechanism I performed 3SLS estimates, but the results are very much the same as those of the 2SLS estimates.

excluded in the wage regression.[18]

In all 2SLS-estimates the wage effects of alcohol use and tobacco use are implausibly large. Apparently, it is difficult to find good instrumental variables. In the usual analysis the selection equation relates the endogenous variables in the wage equation to a set of instrumental variables that are related to the endogenous variables but are not directly related to the wage. Instrumental variables are used as an approximation to randomized trials (Angrist and Krueger, 2001). The validity of an instrumental variable estimation depends crucially on the assumption that the instruments are uncorrelated with other latent characteristics of individuals that may affect their earnings. However, even the use of identical twins does not go without discussion since their abilities may differ, biasing the estimates (Card, 1999). The effect of for example alcohol use on the wage is identified if the researcher has an instrumental variables like for example illnesses. Even then, identification depends crucially on the assumption that illnesses do not directly affect the wage but only have an indirect effect through alcohol use. By the nature of the problem this assumption cannot be tested. It is well-known that in studies that relate wages to alcohol use it is difficult to find appropriate instruments. French and Zarkin (1995) for example only report OLS parameter estimates because of the lack of reasonable instruments. Zarkin et al. (1998) perform 2SLS but do not report the results the estimates "were implausibly large".[19] Auld (1998) finds that 2SLS and 3SLS estimates of the wage effects of smoking and drinking are four to five times as large as OLS estimates.[20] Therefore, in the next subsection I present an alternative procedure to correct for the effect of unobserved heterogeneity.

[18] Although the coefficient of tobacco use is now estimated with less precision than before.

[19] Zarkin et al. (1998) re-estimated an augmented wage equation that included their instruments. They report that the alcohol use coefficients were essentially unchanged from the OLS specification. If I do this for the wage equation with dummy variables for alcohol use and tobacco use and add as instruments 'partner' and 'early use of alcohol' I find a coefficient (absolute t-value) of 0.105 (2.1) for alcohol use and -0.047 (1.8) for tobacco use. So here too the OLS parameter estimates are hardly affected by the inclusion of instrumental variables.

[20] According to Auld (1998) these results are "difficult to interpret for policy purposes because the estimated effects of substance use behavior are too large to plausibly interpreted as causal effects".

4.3 An alternative way to correct for unobserved heterogeneity

The starting point of the alternative analysis is the assumption that possible unobserved characteristics of individuals that affect their wages follow a discrete distribution with an unknown number of points of support.

$$w_i = \gamma_1 x_i + \gamma_2 \widetilde{y}_{1i} + \gamma_3 \widetilde{y}_{2i} + \delta_i + \epsilon_i \tag{9}$$

where δ_i is a random effect. As in Mroz (1999) additional points of support are added in a stepwise manner. The second column of Table 8 shows the parameter estimates of such a wage equation if δ_i is assumed to have two points of support (δ_0, δ_1), with $\Pr(\delta_i = \delta_0) = p$ and $\Pr(\delta_i = \delta_1) = 1 - p$. Here p has a logit specification with $p = \frac{\exp(\alpha_1)}{1+\exp(\alpha_1)}$ and because of the presence δ no constant is estimated ($\gamma_0 = 0$). As shown there is a small probability (1%) that an individual has a much higher wage (about double) than the rest of the individuals.[21] The parameter estimates of alcohol use and tobacco use are not very much influenced by the introduction of the random effects.

The third column of Table 8 shows the parameter estimates if δ is assumed to have three points of support. $(\delta_0, \delta_1, \delta_2)$, with $\Pr(\delta_i = \delta_0) = p_1$, $\Pr(\delta_i = \delta_1) = p_2$ and $\Pr(\delta_i = \delta_2) = p_3$. Now $0 \leq p_n \leq 1,\ n = 1,..,3.$ and $p_n = \exp(\alpha_n)/(1 + \underset{n}{\Sigma} \exp(\alpha_n))$, normalizing $\alpha_3 = 0$, to have a multinomial logit specification. As shown, again the parameter estimates including the ones of alcohol use and tobacco use are not very much affected. The precision of the parameter estimate of alcohol use falls somewhat.[22]

From these estimation results it is clear that there are unobserved characteristics of individuals that affect their wages. In Section 3 it was shown that there are also unobserved characteristics that affect the starting rates with respect to the consumption of alcohol and tobacco. Taking a possible correlation between the unobserved characteristics of the various processes into account is an alternative way to account for spurious effects of alcohol use and tobacco use on wages.

The starting point of the analysis is a four point distribution of unobserved heterogeneity for both the wage equations and the starting rates

[21] The Likelihood Ratio test statistic comparing a model with and without the random effects is equal to 7.8 for the upper part of Table 8 and 8.8 for the lower part, which would be significant at a 5% level and 2 degrees of freedom (the critical $\chi^2_{0.05} = 6.0$). However, note again that a formal $LR-$test is problematic since one of the parameters (p) is not identified under the null hypothesis.

[22] As shown in footnotes d and e of Table 8 introducing four mass points only improves the estimation results a little bit. These footnotes also shows that introducing two mass points in the wage equation for females hardly affect the loglikelihood value.

of alcohol use and tobacco use:

$$\Pr(v_a = v_{1,a}, v_b = v_{1,b}, \delta = \delta_0) = p_1 \quad \Pr(v_a = v_{1,a}, v_b = v_{2,b}, \delta = \delta_1) = p_2$$

$$\Pr(v_a = v_{2,a}, v_b = v_{1,b}, \delta = \delta_2) = p_3 \quad \Pr(v_a = v_{2,a}, v_b = v_{2,b}, \delta = \delta_3) = p_4 \tag{10}$$

The wage equation and starting rates are estimated jointly using maximum likelihood. The parameter estimates are shown in Table 10. As was the case before it is not possible to distinguish four points of support, but three points of support are identified. Because the parameter estimates in the left part of the table (alcohol and tobacco use continuous variables) are about the same as the one in the right part (alcohol and tobacco use dummy variables) and most of the parameter estimates do not differ much from previous ones I focus the discussion to the pattern of unobserved heterogeneity and the newly estimated wage effects of alcohol use and tobacco use if specified as dummy variables.

The estimates of the distribution of unobserved heterogeneity indicates that conditional on the observed characteristics there are three groups of individuals. There is a group of 87% that has high starting rates of alcohol use and tobacco use and an medium wage. Furthermore, there is a group of 12% that has low starting rates of alcohol use, a zero starting rate of tobacco use and a low wage. Finally there is a group of 1% that has a high starting rate of alcohol use, a zero starting rate of tobacco use and a high wage. Since this last group is so small there is almost perfect correlation between the unobserved characteristics.

The parameter estimates imply that males that are inclined to drinking and smoking have a higher wage than otherwise similar individuals that do not have a strong inclination to drink or smoke. If this is not taken into account the positive wage effect of alcohol is overestimated and the negative wage effect of tobacco is underestimated.[23] The parameter estimates in the left-hand side of Table 10 imply that for an average drinker wages are 6.7% above the wage of an otherwise identical abstainer, while an average smoker has a wage 8.7% below the wage of an otherwise identical non-smoker. Due to the logarithmic specification of the use-variable there are decreasing returns to drinking and smoking. An individual that drinks twice the average has a wage bonus of 7.8% while an individual that smokes twice the average faces a wage penalty of 11.9%. The parameter estimates in the right-hand side of Table 10

[23]Note that no particular correlation structure is imposed. It is the information in the data that leads to the conclusion that unobserved characteristics that are positively related to smoking and negatively related to drinking have a negative effect on wages. This causes the overestimation of the positive effect of drinking on wages and causes the underestimation of the negative effect of smoking on wages.

imply that a drinker has a wage that is 9.8% higher than an otherwise identical non-drinker while a smoker has a wage that is 8.5% lower than an otherwise identical non-smoker.[24] For both estimates it holds that the positive effect of drinking is about the same as the negative effect of smoking: smoking cancels out the positive wage effects of drinking.

5 Conclusions

This paper deals with the effects of the use of tobacco and alcohol on wages. The data are from a December 2001 survey in the Netherlands. From the analysis it appears that the wages of females are not affected by smoking and drinking. For males smoking has a negative effect on wages while drinking has a positive effect. The size of the effect is almost independent of the intensity of smoking or drinking. I use an alternative method to account for possible joint unobserved determinants of the wage and the use of alcohol and tobacco. It appears that there are unobserved characteristics of individuals that cause differences in earnings between smokers and non-smokers and between drinkers and non-drinkers. Ceteris paribus non-drinkers and non-smokers earn less than drinkers and smokers do. This means that if one does not account for this the positive wage effect of drinking is over-estimated while the negative effect of smoking is under-estimated. Taking the effect of unobserved heterogeneity into account I find that alcohol users earn about 10% more than non-drinkers while smokers earn about 10% less than non-smokers do.

As it is not clear *why* drinking increases wages and smoking reduces wages it is not easy to draw clear policy conclusions from the analysis. Furthermore, the speed of processes is unclear. Most likely the effects are related to health and social networking. If the effects are present because of health reasons then abstention from smoking or - moderate - drinking will have a positive effect on the wages after some time. If the effects are related to social networking the effects may also materialize after some time after behavior has changed but social networks tend to be path-dependent so changes will occur slowly. Nevertheless, it seems fair to say that alcohol use increases the wage, but smoking blows that wage gain away.

[24]The coefficient of alcohol use is on the borderline of significance. This has to do with the substantial variation in the wages of males that are mild users of alcohol. If I specify the dummy for alcohol use to cover the range above 2 drinks per month I find a coefficient of 0.073 with an absolute t-statistic of 2.2. Table 9 also shows that imposing a restriction of no random effects in the wage equation reduces the loglikelihood with 3-4.4 points. For two degrees of freedom this would be on the borderline of significance for the left-hand side of the table and clearly significant for the right-hand side of the table (critical $\chi^2_{0.05} = 6.0$).

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6 Appendix: Information about the data

6.1 CentER-data data

CentER-data exploits an Internet-based panel consisting of some 2000 households in the Netherlands. Every week, the panel members fill in a questionnaire on the Internet, while being at home. The CentERpanel is representative of the Dutch population in terms of age, sex, religion, education, region, and province. The data on the use of alcohol and tobacco were collected in the week before Christmas 2001. The questions about smoking and drinking are questions typically asked like lifetime prevalence, last year prevalence, last month prevalence, frequency of use ever, normal current use. The data about the personal characteristics and labor market position were drawn from the available information about the panel members.

6.2 Definition of variables

In the analysis the following explanatory variables are used:

- Age: Age of individuals at the time of the survey.
- Primary education: Dummy variable with a value of 1 if the individual attended extended primary education after having attended basic education, and a value of 0 otherwise.
- Secondary education: Dummy variable with a value of 1 if the individual attended secondary general or vocational education, and a value of 0 otherwise. Secondary education refers to intermediate vocational or secondary general education.
- Higher education: Dummy variable with a value of 1 if the individual attended higher vocational or academic education, and a value of 0 otherwise. Since there are three dummy variables for education the overall reference group consists of individuals with only basic education.
- Children: Dummy variable with a value of 1 if the individual has children and a value of 0 otherwise.
- Partner: Dummy variable with a value of 1 if the individual has a partner and a value of 0 otherwise.
- Catholic: Dummy variable with a value of 1 if the individual indicates to be Catholic and a value of 0 otherwise.

- Protestant: Dummy variable with a value of 1 if the individual indicates to be Protestant and a value of 0 otherwise.
- SES-low: Dummy variable with a value of 1 if the individual has a low value for the socioeconomic class indicator and a value of 0 otherwise. The socioeconomic class indicator is an ordinal variable based on information about the education and occupation of the main breadwinner of the household.
- Early start tobacco (alcohol) use: Dummy variable with a value of 1 if the individual indicated to have started using tobacco (alcohol) before the age of 16.
- Intensity of tobacco use: number of cigarettes, cigars or pipes the individual 'normally' smokes during a day.
- Intensity of alcohol use: number of glasses of alcohol (beer, wine, gin) the individual 'normally' drinks during a month.
- lifetime prevalence: based on the question: did you ever use (tobacco, alcohol) up to last year?
- Last year prevalence: based on the question: did you use (tobacco, alcohol) last year (up to last month)?
- Last month prevalence: based on the question: did you use (tobacco, alcohol) last month?
- Hourly wage calculated as the individual gross monthly income divided by the monthly hours of work (= weekly hours of work *13/3)

Tables A1 and A2 present the characteristics of the full dataset and the dataset used in the wage regressions.

Table A1 General characteristics of the full dataset

	Males				Females			
	Mean	Min	Max	N	Mean	Min	Max	N
Age	48.5	16	86	1010	44.5	16	86	820
Education								
Primary	0.19	0	1	1010	0.25	0	1	820
Secondary	0.35	0	1	1010	0.37	0	1	820
Higher	0.41	0	1	1010	0.29	0	1	820
Family								
Children	0.38	0	1	1010	0.44	0	1	820
Partner	0.77	0	1	1010	0.76	0	1	820
Religion								
Catholic	0.34	0	1	1010	0.33	0	1	820
Protestant	0.20	0	1	1010	0.21	0	1	820
SES-low	0.20	0	1	1010	0.23	0	1	820
Drug use								
Early start tobacco	0.50	0	1	740	0.42	0	1	489
Early start alcohol	0.37	0	1	915	0.32	0	1	675
Tobacco use	12.5	1	125	408	13.1	1	40	288
Alcohol use	49.0	1	600	912	26.7	1	600	690
lifetime prevalence								
Tobacco	0.76	0	1	1003	0.61	0	1	815
Alcohol	0.98	0	1	1000	0.92	0	1	812
Last year prevalence								
Tobacco	0.32	0	1	1003	0.29	0	1	815
Alcohol	0.92	0	1	1000	0.84	0	1	812
Last month prevalence								
Tobacco	0.32	0	1	1003	0.28	0	1	815
Alcohol	0.89	0	1	1000	0.77	0	1	812
Wage								
Hourly wage	69.0	0	2163.5	706	33.6	0	757.2	606

Table A2 General characteristics of the dataset used in the wage regressions

	Males				Females			
	Mean	Min	Max	N	Mean	Min	Max	N
Age	41.4	26	55	503	38.5	26	55	335
Education								
Primary	0.17	0	1	503	0.14	0	1	335
Secondary	0.38	0	1	503	0.42	0	1	335
Higher	0.41	0	1	503	0.41	0	1	335
Family								
Children	0.54	0	1	503	0.49	0	1	335
Partner	0.75	0	1	503	0.72	0	1	335
Religion								
Catholic	0.30	0	1	503	0.30	0	1	335
Protestant	0.18	0	1	503	0.17	0	1	335
SES-low	0.20	0	1	503	0.21	0	1	335
Drug use								
Early start tobacco[a)]	0.52	0	1	351	0.44	0	1	201
Early start alcohol[a)]	0.47	0	1	458	0.40	0	1	284
Tobacco use[b)]	11.7	1	45	209	13.1	1	40	119
Alcohol use[b)]	45.8	1	600	469	26.6	1	600	286
Wage								
Hourly wage	33.0	14.4	66.3	503	28.9	11.0	64.3	336

[a)] Conditional on lifetime prevalence = 1
[b)] Conditional on use > 0

Table 1 Labor market situation by age category and gender

Males	Employed (%)	Unemployed (%)	Non-participants (%)	Total (%)	Total (Number)
16-25 yrs	54	3	43	100	37
26-35 yrs	95	2	3	100	168
36-45 yrs	96	2	2	100	255
46-55 yrs	88	3	9	100	236
56-65 yrs	39	2	59	100	150
65+ yrs	2	1	97	100	164
Total	69	2	29	100	1010
Females					
16-25 yrs	53	6	41	100	51
26-35 yrs	86	4	10	100	203
36-45 yrs	74	3	23	100	221
46-55 yrs	65	7	28	100	158
56-65 yrs	17	0	83	100	99
65+ yrs	2	0	98	100	88
Total	59	3	37	100	820

Table 2 The use of tobacco and alcohol by age group and gender (% of total)[a]

	Prevalence tobacco			Prevalence alcohol		
	Lifetime	Last year	Last month	Lifetime	Last year	Last month
Males						
16-25 yrs	32	30	30	97	97	95
26-35 yrs	57	38	38	96	91	88
36-45 yrs	67	35	33	96	93	89
46-55 yrs	85	39	38	98	93	92
56-65 yrs	85	31	31	99	95	93
65+ yrs	91	30	15	95	87	84
Females						
16-25 yrs	35	24	20	92	92	84
26-35 yrs	55	30	27	90	80	70
36-45 yrs	67	34	33	92	86	79
46-55 yrs	72	31	30	94	86	79
56-65 yrs	59	30	30	94	89	87
65+ yrs	57	24	16	86	77	77

[a] Lifetime prevalence ever use up to last year; Last year prevalence use during last year up to last month; Last month prevalence use during last month

Table 3 Intensity of use (more than 25 times ever; % of total)

	Males		**Females**	
	Tobacco	Alcohol	Tobacco	Alcohol
16-25 yrs	30	78	22	65
26-35 yrs	49	89	44	78
36-45 yrs	56	89	52	79
46-55 yrs	65	89	56	83
56-65 yrs	61	93	44	81
65+ yrs	65	87	38	74

Table 4 'Normal' use of tobacco and alcohol by males and females; age 26-55 years

	Tobacco			Alcohol	
Number/day	Males	Females	Number/month	Males	Females
0	57	63	0	7	16
1-2	11	8	1-5	15	31
3-10	10	9	6-16	18	18
11-20	14	15	17-31	20	15
20+	8	5	32-62	19	11
			63-93	7	4
			94-124	8	3
			124+	6	2
Total (%)	100	100		100	100
Total (number)	659	582		659	582
Average if positive	13.21	13.46		48.78	25.60
Overall average	5.65	7.77		45.15	21.47

Table 5 Parameter estimates starting rates of tobacco and alcohol[a)]

	Males		Females	
	Tobacco	Alcohol	Tobacco	Alcohol
Education				
Primary	-0.13 (0.3)	-0.10 (0.3)	-0.26 (0.7)	0.17 (0.6)
Secondary	-0.55 (1.4)	-0.12 (0.4)	-0.40 (1.2)	0.35 (1.4)
Higher	-0.58 (1.5)	-0.01 (0.0)	-0.61 (1.8)	0.54 (2.0)
Religion				
Catholic	-0.02 (0.1)	-0.09 (0.8)	-0.29 (2.1)	0.01 (0.1)
Protestant	-0.09 (0.5)	-0.14 (0.9)	-0.53 (2.8)	-0.14 (1.0)
Age dependence				
11	0.20 (0.6)	-1.22 (2.6)	0.01 (0.1)	-2.38 (2.2)
12	0.69 (2.1)	0.18 (0.6)	2.09 (3.3)	0.46 (1.1)
13	0.88 (2.7)	0.22 (0.7)	2.33 (3.7)	0.06 (0.1)
14	1.43 (4.7)	1.54 (5.8)	3.03 (4.9)	1.74 (5.0)
15	1.99 (6.6)	2.07 (8.0)	3.24 (5.2)	2.17 (6.4)
16	2.09 (6.6)	2.67 (10.1)	3.54 (5.2)	2.83 (8.4)
17	1.52 (4.3)	2.42 (8.5)	3.34 (5.2)	2.24 (6.3)
18	2.16 (5.8)	2.25 (7.1)	3.27 (4.9)	2.80 (7.9)
19	1.41 (3.4)	1.18 (2.7)	2.18 (3.0)	1.87 (4.5)
≥ 20	-0.40 (1.0)	0.07 (0.2)	0.60 (0.9)	0.38 (1.1)
Mass points				
v_1	-3.10 (6.6)	-3.25 (8.7)	-4.61 (6.7)	-2.38 (2.2)
$v_2 - v_1$	$-\infty$	-0.90 (2.0)	$-\infty$	-1.17 (0.6)
Heterogeneity				
α_1	1.88 (3.1)		2.56 (1.6)	
$-Loglikelihood$	3188.25		2720.70	
$-Logl.$ $(v_2 = v_1)$	3196.96		2723.51	

[a)] 659 males and 582 females age 26-55 years; maximum likelihood estimates; absolute t-values in parentheses.

Table 6 Parameter estimates intensity of use of tobacco and alcohol[a)]

	Males		Females	
	Tobacco	**Alcohol**	**Tobacco**	**Alcohol**
Age	0.012 (1.8)	0.036 (4.9)	0.008 (1.4)	0.042 (5.8)
Education				
Primary	-0.36 (1.2)	-0.08 (0.2)	-0.48 (1.8)	0.38 (1.1)
Secondary	-0.20 (0.7)	-0.04 (0.1)	-0.58 (2.2)	0.37 (1.1)
Higher	-0.39 (1.2)	0.15 (0.4)	-0.88 (3.3)	0.47 (1.4)
Family				
Children	-0.09 (0.8)	-0.08 (0.6)	-0.05 (0.4)	-0.18 (1.4)
Partner	-0.46 (3.3)	-0.09 (0.6)	-0.37 (2.9)	-0.12 (0.8)
Religion				
Catholic	-0.02 (0.2)	-0.04 (0.4)	-0.18 (1.6)	-0.29 (2.2)
Protestant	-0.15 (1.1)	-0.06 (0.3)	0.01 (0.1)	-0.33 (2.1)
SES-low	0.26 (1.8)	-0.05 (0.3)	0.49 (3.7)	0.17 (1.1)
Previous use				
Early start	0.57 (5.3)	0.50 (4.5)	0.69 (5.9)	0.79 (6.3)
Constant	0.93 (2.1)	1.41 (2.9)	2.19 (3.0)	0.09 (0.4)
$\overline{R}^2$	0.084	0.051	0.162	0.122

[a)] 659 males and 582 females age 26-55 years; the dependent variable is $ln(use + 1)$; OLS parameter estimates, absolute t-values in parentheses.

Table 7 Parameter estimates wage regressions I (OLS)[a]

	Males	**Females**
Age	0.012 (7.4)	0.006 (3.1)
Primary education	0.035 (0.4)	0.074 (0.6)
Secondary educ	0.123 (1.6)	0.137 (1.2)
Higher education	0.346 (4.5)	0.362 (3.1)
Tobacco use[b]		
1-2	-0.030 (0.8)	0.059 (0.8)
3-10	-0.107 (2.7)	0.028 (0.6)
11-20	-0.057 (1.4)	-0.048 (1.1)
20+	-0.097 (1.6)	-0.001 (0.0)
Alcohol use[c]		
1-5	0.074 (1.2)	-0.012 (0.2)
6-16	0.141 (2.6)	0.070 (1.4)
17-31	0.105 (1.8)	0.022 (0.4)
32-62	0.129 (2.3)	0.059 (1.0)
63-93	0.265 (3.9)	0.118 (1.4)
94-124	0.139 (1.9)	0.130 (1.1)
124+	0.039 (0.6)	0.260 (1.9)
Constant	2.65 (21.8)	2.82 (20.0)
$\overline{R}^2$	0.294	0.186

[a] 503 males and 335 females age 26-55 years; OLS parameter estimates, absolute t-values in parentheses.

[b] Number of cigarettes, cigars or pipes per day

[c] Number of glasses of alcohol per month

Table 8 Parameter estimates wage regressions II (maximum likelihood)[a]

	Males	**Males**	**Males**	**Females**
Age	0.013 (7.7)	0.014 (8.5)	0.014 (8.8)	0.006 (3.4)
Primary education	0.021 (0.3)	0.023 (0.3)	0.017 (0.2)	0.084 (0.7)
Secondary educ	0.123 (1.5)	0.131 (1.6)	0.120 (1.7)	0.138 (1.3)
Higher education	0.340 (4.3)	0.357 (4.5)	0.356 (4.9)	0.357 (3.3)
Tobacco use[b]	-0.026 (2.6)	-0.025 (2.5)	-0.025 (2.6)	-0.007 (0.6)
Alcohol use[b]	0.020 (2.2)	0.018 (2.0)	0.015 (1.8)	0.024 (2.1)
δ_0	2.687 (24.2)	1.763 (10.1)	1.837 (10.4)	2.804 (22.0)
$\delta_1 - \delta_0$	–	0.880 (6.8)	0.735 (5.6)	–
$\delta_2 - \delta_0$	–	–	1.087 (8.0)	–
α_1	–	-4.894 (6.7)	-2.916 (3.9)	–
α_2	–	–	1.185 (2.2)	–
σ	0.269 (27.6)	0.258 (28.4)	0.205 (12.3)	0.279 (23.4)
$-Loglikelihood$[d]	52.6	48.7	46.0	47.1
Age	0.013 (7.9)	0.014 (8.7)	0.014 (8.5)	0.007 (4.0)
Primary education	0.025 (0.3)	0.026 (0.3)	0.027 (0.4)	0.087 (0.8)
Secondary educ	0.123 (1.5)	0.130 (1.6)	0.126 (1.8)	0.148 (1.3)
Higher education	0.346 (4.3)	0.361 (4.5)	0.367 (5.1)	0.376 (3.3)
Tobacco use[c]	-0.058 (2.3)	-0.056 (2.4)	-0.059 (2.4)	0.011 (0.3)
Alcohol use[c]	0.128 (2.6)	0.127 (2.4)	0.111 (1.9)	0.037 (0.9)
δ_0	2.610 (21.7)	1.614 (9.5)	2.500 (21.9)	2.768 (20.8)
$\delta_1 - \delta_0$	–	0.953 (9.0)	-0.769 (4.3)	–
$\delta_2 - \delta_0$	–	–	0.356 (6.8)	–
α_1	–	-5.119 (7.0)	1.353 (2.5)	–
α_2	–	–	2.501 (21.9)	–
σ	0.268 (27.3)	0.258 (29.8)	0.210 (10.5)	0.280 (23.5)
$-Loglikelihood$[e]	52.2	47.8	45.2	49.0

[a] 503 males and 335 females age 26-55 years; maximum likelihood parameter estimates, absolute t-values in parentheses.
[b] Ln(use+1); tobacco use (no./day), alcohol use (no./month).
[c] Dummy variable value 1 if use > 0, value 0 otherwise.
[d] -Loglikelihood values for males with 4 mass points 46.0, for females with 2 mass points 45.4.
[e] -Loglikelihood values for males with 4 mass points 45.0, for females with 2 mass points 47.0.

Table 9 Estimation results wage regressions III (2SLS)[a]

	Females	Males	Males
Age	0.007 (2.5)	0.011 (4.7)	0.011 (4.0)
Primary education	0.080 (0.6)	-0.005 (0.1)	-0.024 (0.2)
Secondary educ	0.173 (1.2)	0.122 (1.2)	0.106 (0.9)
Higher education	0.425 (2.8)	0.277 (2.9)	0.241 (2.0)
Tobacco use[b]	0.060 (1.1)	-0.123 (2.4)	-0.225 (2.6)
Alcohol use[b]	-0.001 (0.0)	0.114 (2.0)	0.124 (1.8)
Constant	2.741 (17.4)	2.601 (17.2)	2.666 (14.1)
$\overline{R}^2$	0.171	0.180	0.117
Instruments[c]	Partner Early alcohol use Early tobacco use		Partner Early alc use

	Males	Males	Males
Age	0.011 (4.6)	0.011 (4.5)	0.011 (4.2)
Primary education	-0.012 (0.1)	-0.014 (0.1)	-0.010 (0.1)
Secondary educ	0.110 (1.1)	0.109 (1.1)	0.114 (1.2)
Higher education	0.264 (2.6)	0.261 (2.4)	0.268 (2.4)
Partner	-	-	0.03 (0.4)
Tobacco use[b]	-0.166 (2.1)	-0.176 (1.7)	-0.168 (1.5)
Alcohol use[b]	0.111 (1.7)	0.114 (1.8)	0.113 (1.8)
Constant	2.641 (16.5)	2.645 (15.6)	2.626 (14.6)
$\overline{R}^2$	0.150	0.143	0.148
Instruments[c]	Children Early alc use	Low SES Early alcohol use	

[a] 503 males and 335 females age 26-55 years; parameter estimates using 2SLS, absolute t-values in parentheses.
[b] Ln(use+1) as continuous variable; alcohol use = no./month; tobacco use = no./day

Table 10 Parameter estimates joint estimation of wage equation and starting rates of tobacco use and alcohol use[a)]

	(1)		(2)	
	Tobacco	**Alcohol**	**Tobacco**	**Alcohol**
Starting rates				
Primary education	0.11 (0.2)	-0.11 (0.3)	-0.30 (0.7)	-0.14 (0.4)
Secondary educ	-0.27 (0.6)	-0.19 (0.5)	-0.57 (1.0)	-0.25 (0.6)
Higher education	-0.37 (0.8)	0.02 (0.1)	-0.70 (1.2)	-0.06 (0.2)
Catholic	0.13 (0.7)	-0.21 (1.5)	-0.02 (0.1)	-0.23 (1.6)
Protestant	-0.18 (0.9)	-0.12 (0.6)	-0.05 (0.2)	-0.13 (0.7)
Mass points				
v_1	-3.37 (6.2)	-3.11 (6.8)	-3.23 (5.2)	-3.08 (6.7)
$v_2 - v_1$	$-\infty$	-0.67 (3.7)	$-\infty$	-0.96 (2.5)
Wages				
Age	0.013 (7.5)		0.013 (7.8)	
Primary education	0.017 (0.2)		0.019 (0.3)	
Secondary educ	0.124 (1.8)		0.120 (1.8)	
Higher education	0.338 (4.9)		0.339 (5.0)	
Tobacco use	-0.032 (3.0)[b)]		-0.085 (2.9)[c)]	
Alcohol use	0.016 (1.7)[b)]		0.098 (1.7)[c)]	
Mass points				
δ_0	2.727 (26.7)		2.684 (23.5)	
$\delta_1 - \delta_0$	0.241 (1.4)		0.380 (0.6)	
$\delta_2 - \delta_0$	-0.114 (2.1)		-0.194 (2.5)	
Heterogeneity				
α_1	2.46 (3.1)		4.20 (1.5)	
α_2	1.35 (1.4)		2.23 (0.9)	
σ	0.26 (29.8)		0.26 (30.1)	
$-Loglikelihood$	2473.9		2474.5	
$-Logl.\ (\delta_1 = \delta_2 = \delta_0)$	2470.9		2470.1	

[a)] 503 males age 26-55 years; maximum likelihood parameter estimates, absolute t-values in parentheses. To save space the coefficients for age dependence in the starting rates are not reported. These coefficients are almost the same as the ones reported in Table 5.
[b)] Ln(use+1) as continuous variable
[c)] Dummy variable (use>0)

Figure 1a Starting rates for smoking

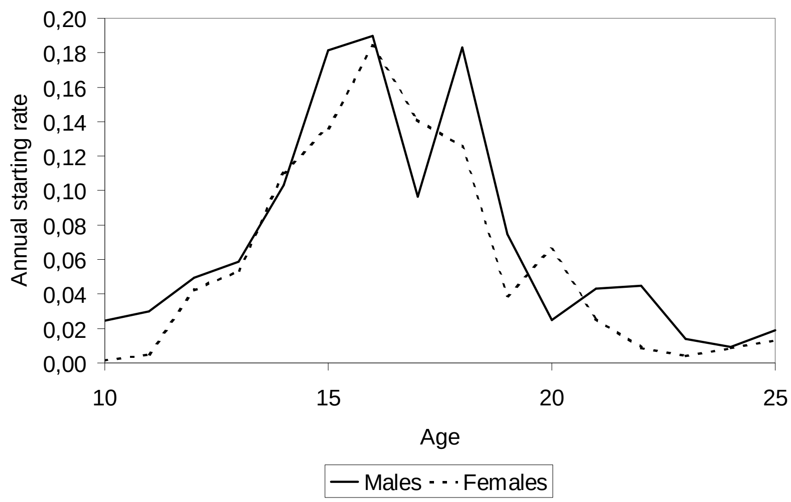

Figure 1b Starting rates for alcohol